Supplementary Materials S1: Quantification Scales for Co-Intelligence Relationships

Resource Dependency ($Res_{i,j}$): This quantifies the degree to which service component i relies on resources provided by service component j. It captures shared resource utilization from the physical or cyber resource layers (e.g., shared sensor data, common optimization algorithms). The quantification follows a scale based on overlap levels of shared resources, derived from expert knowledge as shown in Table 1.

Table S1. Quantification Scale for Resource Dependency.

Relationship Description	Quantified Value ($Res_{i,j}$)
No resource overlap between services	0.0
Partial temporal/spatial overlap of shared co-intelligent resources	0.2
Weak overlap of shared co-intelligent resources	0.4
Over 50% overlap of shared co-intelligent resources	0.6
Majority overlap or strong correlation of shared resources	0.8
Complete resource overlap, resources indispensable	1.0

Directed Overlap in Processes ($Arrow_{i,j}$): This measures the degree of directional overlap or sequential dependence between processes involving components i and j. It captures situations where the output or state of component i directly influences component j in a process flow (e.g., information generated by i guides the configuration of j). The quantification follows a scale based on directional interaction, derived from expert knowledge as detailed in Table 2.

Table S2. Quantification Scale for Directed Overlap in Processes.

Relationship Description	Quantified Value ($Arrow_{i,j}$)
Indirect directed interaction via a third party (physical, cyber, information)	0.2
Weak direct directed interaction	0.4
Strong direct directed interaction	0.6
Strong and exclusive direct directed interaction	0.8
Exclusive bidirectional cyclic directed interaction	1.0

Direct Functional Correlation ($Direct_{i,j}$): This assesses the inherent functional linkage or parallelism between the activities performed by components i and j, independent of sequential process flow or shared resources. It captures direct parallel responsibilities or tightly coupled functionalities (e.g., fault diagnosis and fault reporting are inherently linked). The quantification follows a scale based on inherent functional ties, derived from expert knowledge as illustrated in Table 3.

Table S3. Quantification Scale for Direct Functional Correlation.

Relationship Description	Quantified Value ($Direct_{i,j}$)
No correlation between any components	0.0
Indirect correlation via a third party	0.2
Weak direct correlation	0.4
Over 50% direct correlation	0.6
Majority components tightly linked for co-intelligence	0.8
All components strongly and directly correlated, no removal	1.0

Supplementary Materials S2: IT2 Fuzzy Decision Matrix

Table S4. IT2 Fuzzy Decision Matrix for Office Building Modular Solutions.

Solution	Service Adaptability	Inter-module Independence	Intra-module Synergy	Deployment Simplicity	Economic Efficiency
A1	[(4.25, 5.25, 6.25), (3.5, 5.25, 6.75)]	[(2.0, 3.0, 4.0), (1.5, 3.0, 4.5)]	[(2.80, 3.80, 4.80), (2.00, 3.80, 5.00)]	[(1.50, 2.50, 3.50), (0.80, 2.50, 4.00)]	[(3.00, 4.00, 5.00), (2.50, 4.00, 5.50)]
A2	[(5.00, 6.00, 7.00), (4.50, 6.00, 7.50)]	[(3.50, 4.50, 5.50), (2.80, 4.50, 5.80)]	[(4.00, 5.00, 6.00), (3.30, 5.00, 6.50)]	[(3.00, 4.00, 5.00), (2.30, 4.00, 5.30)]	[(4.50, 5.50, 6.50), (3.80, 5.50, 6.80)]
A3	[(5.75, 6.75, 7.75), (4.75, 6.75, 8.25)]	[(5.00, 6.00, 7.00), (4.00, 6.00, 7.50)]	[(5.00, 6.00, 7.00), (4.00, 6.00, 7.50)]	[(4.50, 5.50, 6.50), (3.80, 5.50, 6.80)]	[(5.50, 6.50, 7.50), (4.50, 6.50, 8.50)]
A4	[(6.50, 7.50, 8.50), (5.50, 7.50, 9.00)]	[(6.00, 7.00, 8.00), (5.00, 7.00, 8.50)]	[(6.00, 7.00, 8.00), (5.00, 7.00, 8.50)]	[(6.00, 7.00, 8.00), (5.00, 7.00, 8.50)]	[(6.50, 7.50, 8.50), (5.50, 7.50, 9.00)]